Occultation Newsletter

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Joan Bixby Dunham, Editor

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FROM THE PUBLISHER

This issue of **ON** has been delayed by the need to produce and distribute the occultation predictions. For subscription purposes, this is the fourth and last issue of 1993. It is the second issue of Volume 6. IOTA annual membership dues, including **ON** and supplements for

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Although they are available to IOTA members without charge, nonmembers must pay for these items:

Local circumstance (asteroidal appulse) predictions	1.00
Graze limit and profile predictions (per graze)	1.50
Papers explaining the use of the predictions	2.50

Asteroidal occultation supplements will be available at extra cost: for South America via Orlando A. Naranjo (Universidad de los Andes; Dept. de Fisica; Merida, Venezuela), for Europe via Roland Boninsegna (Rue de Mariembourg, 33; B-6381 DOURBES; Belgium) or IOTA/ES (see below), for southern Africa via M. D. Overbeek (Box 212; Edenvale 1610; Republic of South Africa), for Australia and New Zealand via Graham Blow (P.O. Box 2241; Wellington, New Zealand), and for Japan via Toshio Hirose (1-13 Shimomaruko 1-chome; Ota-ku, Tokyo 146, Japan). Supplements for all other areas will be available from Jim Stamm (11781 N. Joi Drive; Tucson, AZ 85737; U.S.A.) for $2.50.

Observers from Europe and the British isles should join IOTA/ES, sending DM 40.-- to the account IOTA/ES; Bartold-Knaust Strasse 8; D-30459 Hannover, Germany; Postgiro Hannover 555 829 - 303; bank-code-number (Bankleitzahl) 250 100 30.

IOTA NEWS

David W. Dunham

Long Delay: This is the first year that the lunar occultation prediction computation is being done almost solely by the efforts of IOTA members, using PC-based software (ILOC computed and distributed most of the total lunar occultation predictions for observers outside of Europe and North America). The delay in producing this issue has been caused mainly by work that I needed to do to help get accurate graze predictions to IOTA members worldwide. Most of this was accomplished before the crescent Moon passed through the northern Milky Way in mid-April. The graze prediction situation is now under control, thanks also to much work by Eberhard Riedel. I decided that it was more important to maintain this important IOTA service than to get the **ON** out on time. Work with lunar total occultation predictions, and much work with asteroidal occultations during the first quarter of 1994, also took much time. It's unfortunate that the prediction problems delayed this issue until after both the IOTA meeting and the May 10th eclipse, but the overall situation should improve rapidly during the next few months.

Solar Eclipses: The main purpose of this issue is to give early reports about the May 10th solar eclipse as observed from near the edges of the path of annularity for our project of measuring small variations of the solar diameter. These reports start on the next page. Updates on expeditions for the total solar eclipse on November 3rd in South America are given on p. 41. Issue 3, being distributed with this issue, contains notices about meetings and information on possible occultations and impacts by Comet Shoemaker-Levy 9.

IOTA Observer's Manual: A copy of Wayne Warren's current (1994 March 19th edition) "Script" draft version of the IOTA manual is now being provided to new IOTA members, and can be requested by current members from Craig or Terri McManus in Topeka;

E-mail address 570-0611@mcimail.com or by phoning 913-232-3693. The draft manual is free for IOTA members. Non-IOTA members can obtain the draft manual for $5.00; foreign orders can be charged to MasterCard or Visa. If you can wait, you are encouraged to do so, since the final version of the IOTA Observer's Manual will include descriptions of the new graze predictions, information about "USNO" (now IOTA) total occultation predictions, and other information that is not in the draft version. The draft version is much more legible, and contains much updated information, that is not in the difficult-to-read Preliminary Occultation Manual (POM) distributed during recent years.

IN MEMORIAM

We have the sad task to report the deaths of two IOTA members in the USA and of two IOTA/ES members in Denmark, an especially hard blow to occultation work in that small nation. Each of the four died of cancer. The obituaries for the Danes, Kyril Fabrin and Neils Wieth-Knudsen, will appear in **ON** 6 (4).

Alain Porter: Alain, born in 1958, first joined IOTA as a teenager when he lived in Rhode Island. During the last several years, he worked at National Optical Astronomy Observatories in Tucson, AZ. Alain was one of the first users of the CCD on the Burrell Schmidt at Kitt Peak for studies of elliptical galaxies. He did pioneering research on the X-ray properties of clusters of galaxies and on the spectral energy of high-redshift quasars. He died the day after the shadow of (27) Euterpe swept across Tucson on October 9th last year, but he was too ill during the last months of his tragically short life to observe.

Richard Linkletter: Born on February 20, 1916, Dick died at home in Bremerton, WA, on April 30, 1994. Astronomy was his lifelong avocation, and he worked hard to organize and encourage observers throughout the Pacific Northwest to observe many occultations and grazes. Among the important events that he helped organize were the limit observations of the total solar eclipse in February 1979, a key eclipse for measurements of variations of the solar diameter, and the first occultation of a star by the unusual asteroid (216) Kleopatra in October 1980. From 1938 to retirement in 1974, he worked at the Puget Sound Naval Shipyard, which in 1954 considered him among the top ordnance engineers in the USA. He was a stubborn perfectionist; his obituary in the Bremerton **Sun** quotes, "If you needed help working through an idea or sorting out the mathematics for your analysis, you knew Dick would find time to dive into it enthusiastically with you." This was true of his work in astronomy as well as his job and the naval history that he also pursued.

REPORTS OF THE MAY 10TH ECLIPSE FROM THE ANNULARITY PATH EDGES

David W. Dunham

Some reports are given below from west to east along the eclipse path. After the reports is some information about reporting observations.

Detailed plans to observe the eclipse from both the northern and southern limits of the path of annularity were made at the end of the IOTA meeting in El Paso on Sunday, May 8. Several video records were obtained at both the northern and southern limits. Skies were clear at these sites around El Paso. At the northern limit in New Mexico, nine stations were set up along US 80 where it intersected NM route 9 20 miles s. of Road Fork, in an effort organized by Derald Nye and Mark Trueblood from Tucson, AZ. Hans Bode and other German members of the European Section (ES) of IOTA were at three of the stations. Walter Morgan, Livermore, CA, set up four more stations s. of Truth or Consequences, most manned by observers from Albuquerque. A little farther west and about 30 miles south of the northern limit, Harold Povenmire, Indian Harbour Beach, FL, made visual timings from near Alamogordo, NM.

Bailey's beads were also spectacular at the southern-limit sites, in spite of the smaller mountains along the northern edge of the Moon. We had 5 stations near Sierra Blanca, Texas. At my site a few hundred feet south of the predicted inner edge (limit of true annularity), 3 or 4 small breaks remained in the ring at central eclipse, as expected from the prediction and contrary to the suspected south shift that I reported in an E- mail message that I distributed on May 11. Frank Roylance, a science reporter for the **Baltimore Sun** newspaper, stayed with me during the eclipse and the preparations for it, and wrote good articles mentioning IOTA that were published on page 1B of the May 10th and page 1A of the May 11th editions of the **Sun**. Some selected quotes from these articles: "El Paso, Texas . . . The Johns Hopkins University astronomer and veteran eclipse chaser was surrounded by maps and tuned to the Weather Channel in his frayed hotel room here. At 3 pm Sunday, he watched clouds of Pacific moisture swirling into Texas like cream into a coffee cup.", "As president of IOTA, he was calling the signals for dozens of other scientists, amateurs and reporters from around the world who had gathered here", and "Sierra Blanca, Texas - The quiet rangeland four miles north of this lonely truck stop grew even quieter yesterday. As the Moon's shadow crossed into Texas from Mexico and dimmed the morning sunshine, the temperature fell from 83° to 71°, and the desert birds settled into the sagebrush."

Wayne Hutchinson, Houston, TX, timed beads visually with a filtered C-8 at a site almost a mile south of mine. He could not describe the complex bead pattern for about a minute around the central time, but noticed that the ring remained broken for a 2 - 3° segment at maximum eclipse. German IOTA/ES members made video recordings at the other three stations.

Reports from observers farther east:

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From Paul Maley: Gary Nealis, Houston, TX, videotaped at the south edge from Broken Arrow, Oklahoma. This was my original site and I provided him all the detailed maps. He stuck it out and it was clear at eclipse time, while I went to Kansas City, Richard Nugent went to NM and Ken Wilcox to Emporia KS. Oddly enough all of us got data. Gary used a C5 and direct video--identical to my setup but had to perform numerous manual corrections. To sum up: Richard has 8mm camcorder at the north edge, apparently collocated with people from California. Gary has VHS-C direct, and I have 8mm direct--all with beads.

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Later, from Paul Maley: I reviewed 3 tapes this weekend, mine, Richard Nugent's and Gary Nealis's. Beads can be pulled off mine (and Gary's to a small extent). However, both he and I suffered from distractions by people at our site and drive problems, or I should say manual correction due to the changing crescent orientation.

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Ken Wilcox, Bartlesville, OK: We flew to Emporia, KS whose airport just so happened to be on the northern limit. Danial Johnson from Tulsa, Rick Boswell (pilot) and John Geibel, amateur astronomer from Bartlesville, OK, accompanied me. By flying north 180 miles, skies were perfectly clear. I only had to carry my equipment 50 yards to set up. It was a HOOT!!! I set up my Questar 23 feet due north of a bench mark (could not read the number) at the base of the airport beacon. Danial Johnson established a site about 3/4 mile southeast on a golf course. We used my GPS to get a location of both sites as well as the bench mark.

Using a 3 1/2" Questar and Watec B/W video camera, I got high resolution of the beads as they began at the eastern cusp. Dan used his 4 1/2" Edmund "mortarscope" to project an image on white cardboard which he video taped with an 8 mm camcorder. Both Dan and I used 8 mm Camcorders with a WWV time signal. Dan and I took our 8 mm tapes back to Tulsa where Travis Meyer KTUL, Channel 8 in Tulsa copied it onto VHS. Travis was impressed with video images and played them on his 6 pm and 10 pm weather broadcast.

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Richard Wilds, Topeka, KS: Here are the results of the Heartland Astronomical Research Team's observations of the 1994 May 10 Annular Solar Eclipse near Lyndon, Kansas. Two sites were set up near the northern limit of annularity.

Site 1 was manned by Richard P. Wilds and Craig A. McManus with a 7-inch refractor with mylar solar filter and two 1.5-inch aperture stops. Site was located at Danish cemetery 0.75 miles north of IOTA northern interior limit. Video was recorded with digital WWV time signals to 0.1 seconds. Massive numbers of Bailey's bead events were recorded with extremely high resolution.

Site 2 was manned by Terri A. McManus and Brad May using a 4.5-inch reflector and solar eyepiece projection and recorded on 8mm camcorder with camcorder time displayed and audio WWV time signal. Site was located 0.3 miles south of northern interior IOTA limit. That is 0.2 miles south plus 0.1 miles south TANZ for 0.3 miles south of the northern interior IOTA limit per your instructions. Video and visual observations by both team members indicated annularity broken continuously at this site. However breakage was maintained tenuously. Has the Sun shrunk? With HUNDREDS of simultaneous bead events recorded and changing continuously through central graze, how do we reduce the video!?! Or, do we just send you the tape and let you worry about it?

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Later, from Richard Wilds: I have been reviewing the annular eclipse video and I have a question. When we are within a minute of central graze we have been noticing a continuous thin, faint line along the limb. I figure this is due to the Sun being covered as much as possible and our field of view is so narrow. But what could it be with the filtering being so heavy? Could it be corona, or could it be scattered light from lunar dust storms? These are wild ideas, but this continuous line on the limb is a question. [I saw a similar line on another n. limit tape that I've received, and saw this myself visually on a projected image during the 1984 May eclipse; it seems to be the bright lower edge of the chromosphere. D.W.D.]

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Paul Maley, Houston, TX: I got bead data from Lenexa, Kansas (a s.w. suburb of Kansas City) near the northern limit 1.0 miles north of the inner edge of the 3.8 mile wide band defined by Al Fiala's predictions. The time of annularity was earlier by 3 minutes or so than the prediction. Oddly enough I was 2 blocks from the Garmin GPS company where Ken Willcox's GPS receiver was made. I didn't know that until after the eclipse. I should have precise path data to at least 5m once the differential correction is done over the next month.

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Alan Fiala, USNO: I observed from my first choice location near the southern limit and never had to move. I was on an Air National Guard base on the south edge of Terre Haute, with the most nearly perfect weather for an eclipse that I can recall. It was absolutely cloudless, temperature in the mid-60s, and fairly still except that an eclipse wind came up about 10 minutes before maximum, and I had the van on the wrong side to be a shelter! I tried to use my body.

The video system had not been used since the annular-total in May 1984, and I had made some changes. This is the first time I got an eclipse recorded with the CCD, and it was attached to the Questar and that was set up on the very sturdy video tripod. I had also just bought a folding table on sale at CVS, so the whole thing was the most physically comfortable ever. Although I had set everything up and tested before I left, I had a very hard time getting the solar image on video, and for a while thought the tape deck had gone bad again. It finally turned out that the focus had slipped pretty badly, and also that the finder is not very well centered on the field. I started off with the full aperture solar filter topped by a stop-down diaphragm; near maximum I removed the diaphragm but left the filter on all the way through. Even so, I had blooming effects. The "bad" news was that I was set on the wrong cusp to start with. By the time I realized that, I had to make manual adjustments, so during the bead phenomena there are occasional bad jitters as I reset the position, and I think that I missed part of the early beads. I haven't yet played the tape back but once, so I don't know yet how many good data can be salvaged. There was definitely a good strong time signal on the sound track. That was a concern for a while because I could only get WWV on one frequency, and it faded occasionally.

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Richard Walker, Ortonsville, MI: I recorded the eclipse with a 10-inch f/4.5 stopped down to 3-inch and using a mylar solar filter and a Tuthill CCD video camera at prime focus. I was in my back yard a short distance north of the northern limit. Last contact was clouded out, but the central 10 minutes were recorded well.

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Scott Fearing, Arlington, VA: I took three of my kids out of bed early on eclipse day, bundled them into the car, and high-tailed it from our home in northern Virginia to a school in Braceville, near Newton Falls, Ohio which Joan had said would be right on the southern edge of broken annularity. While the kids were enjoying the eclipse with their special solar glasses I made for them from aluminized Mylar and cardboard, I was able to get a video made through the scope at high power. Skies were very clear and the eclipse was magnificent, appearing like the perfect illustration we all strive for in geometry - two different size circles just joined at the inner edge of the larger. The eclipse never did reach broken annularity from my location but I should have useful information on the tape. With that completed, we all hopped back in the car for the 5 1/2 hour haul past Pennsylvania state troopers always out in force (the state's main source of revenue) and got home in time for me to make my 8 PM performance at the Kennedy Center. Not a moment to spare! The kids got a kick out of it and I was glad they came as their school was not going to let anyone out of the building for fear of a lawsuit if any were blinded. We still have inroads to make in education! It was the same as in Baja in 1991 as some of the natives closed their doors to the beautiful 6+ minutes of totality because of the warnings in the media. Oh well. I'll be sending my data in soon.

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Guy Nason, North York, Ontario: I observed from my home near the northern limit. Tape not bad. Got close-up of Bailey's Beads, but clouds obliterated view for a few seconds exactly at maximum. I'm composing detailed note to include with VHS copy and will cc to zou.

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Tony Cecce, Corning, NY: Just thought I would let you know how we made out. We had two sites set up for video taping. One was clouded out until moments after annularity, I think (haven't seen the tape yet). My site was at the observatory, about 1.2 miles from the predicted southern inner edge. We got a 40 minute break in dark rain clouds about seven minutes before second contact. It was an unbelievable stroke of luck.

No observer was absolutely sure they saw a complete unbroken ring with naked eye observation (through filters). Our tape ended up with a considerable amount of blooming, we assume not enough filtering. It appears that we had continuous bead events that moved smoothly from one cusp to another. We can't tell if the uneven moon edge at mid-eclipse was due to actual beads, or if mountains provided enough reduction in ring width to reduce the blooming in those areas. We can't wait to hear where the actual edge was.

We were also unable to feed in the time signals so we have video only. Let me know if you want a copy of this tape. It may not be useful scientifically, but it sure is a pretty sight to me. Overall, I would say we didn't do too bad for a bunch of first time amateurs on something like this. Thanks for the info you provided, just making the effort put the cherry on a really sweet cake.

The bottom line was we had a great time, which is all that really matters in the end.

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Brad Timerson, Newark, NY: I took my astronomy class to the southern limit just below Ithaca, NY, to coordinate with Jay Edwards from Kopernick Science Center. When we left Newark (NY, near Rochester), skies were clear and sunny. The farther we drove south, the worse it got. After a vote, we all decided to press on and set up three stations as planned. While setting up, we even experienced some light showers. At the appointed time, however, the skies cleared to provide some great viewing. The northernmost station ended up seeing an annular eclipse as they were just north of the southern limit. Station 2 was at a location between the IOTA and NASA internal graze limits, and saw a few events associated with the graze. I was at station 3 just south of #2 and saw a very deep partial eclipse. We never had a complete ring develop. At school in Newark, color videotape was taken as were about 20 black and white stills through an 8" telescope. One videotape from the southern graze as well as some timed slides I took will probably be all that will be useful from our efforts. The kids tried real hard, but sometimes things just don't work out well. One station had trouble with the telescope. We didn't have the best portable equipment. As soon as we have derived exact locations and made copies of the tapes and slides, we'll be ready to send out our results.

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Phil Dombrowski, Glastonbury, CT: I saw the eclipse from Saratoga, NY (S. Limit) under excellent conditions. An annular eclipse is underrated! It was really quite spectacular. Much of the Northeast did OK weatherwise yesterday. I don't think many places were overcast at eclipse time.

COMPOSITE TAPE AND ANALYSIS OF OBSERVATIONS OF THE MAY 10TH ANNULAR ECLIPSE

David W. Dunham, Alan D. Fiala, and Paul D. Maley

About ten days after the eclipse, this was sent to those who made observations near the northern and southern limits of annularity, as far as I know. It is included here, both to inform any observers whom we might have missed in that distribution, and because much of the information will be applicable for future eclipses.

IOTA and Al Fiala at USNO want to do two things during the next one to two months: 1. We want to create a composite tape, including at least two minutes of the central parts of all or most of the videotapes made near the limits of annularity of the May 10th solar eclipse, which will be distributed to each contributor and can be shown at meetings to help promote IOTA and eclipse limit observation in general (the composite tape will also include one or two tapes obtained near the central line, which I believe will show the advantages of observations near the edges of the path of annularity for bead observations), and 2. Do a quick preliminary analysis of some of the observations, and give information to allow complete analysis of all usable observations. For this project, we want to get your tapes, and we will need your help!

If you made visual timings, play back your tape and determine each event timing, just like for a graze. Don't send us your audio tape, unless we ask for it. We'd prefer that you report the observations on IBM-compatible diskette (or by E-mail) in the format described in the file "Soleclob.Doc" that was sent to those who we know made observations near the limits, and which will be supplied upon request to David Dunham. The Soleclob.Doc format is simple, consisting of the date, time (UTC), a code specifying the type of event, and the observation site coordinates.

If you obtained a videotape, please send it to one of the two addresses below:

All PAL (such as German video, actually, any non-NTSC) tapes, and all tapes made near the SOUTHERN limit, to:

David W. Dunham (phone 301-474-4722)
7006 Megan Lane
Greenbelt, MD 20770-3012

All NTSC (North American video standard) tapes made near the NORTHERN limit, to:

Paul D. Maley (phone 713-488-6871)
11815 Lone Hickory Court
Houston, TX 77059

Original tapes are much preferred; make a good copy to keep before you send it. We can use either 8-mm (camcorder) or standard half-inch VHS tapes. We will use the tape to create the composite, and the best quality will result if we have your original tape. Of course, this is also important for the analysis. I will get non-NTSC tapes converted to the NTSC format, and will then return the non-NTSC tape to the sender.

If you obtained some footage showing your observation site and equipment, that would also be useful for including a brief part of it on the composite tape. We will send the best tapes, those for which a detailed analysis will be useful and that have WWV on the audio track, to Tom Campbell in Temple Terrace, FL. He has equipment that can insert a running time display (given to 1/60th of a second) triggered from the WWV minute marks (started from one, and also stopped at one near the end of the observation run, to determine a rate correction). Campbell's VTACT filtration system works for even noisy tapes, as long as some WWV minute markers can be heard at all. The time-inserted copy and the original tape will then be returned to the sender, who will be responsible for playing back the tape, including single-frame and slow mode, to determine the bead timings, see the instructions for visual observers above. For one or two of the very best tapes that we feel could be crucial for the analysis, we will keep them for a short time to determine some of the bead timings ourselves to use in the preliminary analysis, but this is very time consuming work that we MUST rely on the observer for most of the effort. [Note: Some German observers might have equipment from Cuno that might be used to insert a time display, but this would be useful only if it can be triggered from the WWV time signals; I think that Cuno's equipment at the moment can only trigger from the DCF long-wave German time signals]. The northern and southern limit tapes are being sent to separate addresses since most of the tapes were made near the northern limit, and I need someone else to do most of the work. There are problems with each of the southern-limit tapes that I have heard about, including my own (great video, but audio failed), so I want to examine them to see the best way to proceed with their analysis; when I am done with them, I will send them to Paul Maley to complete the composite tape.

After we make the computer run to reduce the timings, we can generate both detailed limb profiles and charts for each timing that will enable you to determine the Watts angle of the mountain or valley causing the bead event. It's useful for us to know whether your image is direct or reversed (as might occur when using projection, or direct observation with a reflecting telescope), since the plots can be produced either way (or copied to a transparency that can be held forward or backward against a TV monitor; specify the diameter of the Moon's disk that you would prefer, although a copying machine with variable magnification could get the image size that you need). I'm sorry that we can't just accept a tape, digitize it, and have computer programs that automatically reduce it; although such a thing may be possible with a lot of work and programming with displays for easy checking, there is no support or time to do this. Maybe this will be done in several years, but not now. Frank Roylance addressed the analysis question at the end of his May 10th article in the **Baltimore Sun**: "The IOTA observations are so numerous, and so time-consuming to process, that many from past eclipses have yet to be analyzed by the Naval Observatory. Dr. Fiala's application for a 3-year federal grant of less than $500,000 to hire personnel to get the work done was recently rejected. 'We got very high ratings,' he said. But no money."

An explanation of exactly how you made the observations, especially the focal length of your telescope or telephoto lens, is needed to complete the record and possibly for the analysis. Of course, we need your longitude, latitude, and height above sea level scaled from the 1:24,000-scale (or 1:50,000-scale for those in Canada) map showing your site. A short discussion about GPS measurements is given in a separate article; some information that I distributed about GPS before the eclipse is misleading and wrong. We'd also like to know the distance of your site north or south (measured perpendicular to the path) of the elevation-corrected inner edge (preferred over outer edge reference) of the northern or southern limit predicted by Alan Fiala. If you don't provide this information, we can figure it out from your coordinates and the predictions, but this will slow down the effort so we'd prefer you to supply it.

ECLIPSE OBSERVING

David W. Dunham

Value of Edge Observations: A solar eclipse observed near the northern or southern limits of annularity or totality is really the ultimate grazing occultation, a graze of our own star, the Sun. With the right equipment and location, dozens (even more than a hundred) of Bailey's bead events can be recorded, far surpassing the number of events that can be seen during a graze of a distant star. The bead events occur for a longer period of time near the limits than at the central line, and are more varied. Besides the more interesting display of Bailey's beads, librations make observations at the limits more useful than those at the central line, where some quick bead events can also be recorded and timed. At the limits, most of the bead events are caused by features in the lunar polar regions. During eclipses, the latitude libration is always close to zero, so the same lunar mountains and valleys cause bead events during each eclipse. By analyzing beads caused by the same (or nearby) features, the errors in Watts' limb data for these features, typically 0ʺ2 or more, can be considerably reduced or eliminated. This is not the case for central line beads, which are caused by lunar equatorial features that are always different from eclipse to eclipse since the longitude libration can have any value in its 19° range.

Observing Eclipses near the Path Edges: The information given here is more up-to-date than that in the most recent IOTA Observer's Manual. More general information of some use for eclipse observing is given in pertinent chapters from the draft version of the manual: Chapter 4, Accurate Topocentric Position Determination (however, section 4.3.1 about GPS has errors; see the separate article about this below); Chapter 8, Accurate Timing; and Chapter 11, Solar Eclipse Observations. See the section about the draft IOTA manual in IOTA News above.

Timing: For making good timings, an accurate time signal reference is needed, usually provided by the shortwave time stations WWV or CHU. Unfortunately, the convenient TimeKube receivers are no longer sold; other short-wave receivers with digital tuning can be purchased for about $100 and more from Radio Shack and other retailers. A group of observers in a large region might use a strong AM radio station as a secondary standard, if someone takes the lead to select the AM station and record it with WWV (See section 8.1.4.1 of the IOTA Observer's Manual). Most local sources of time, such as telephone time or time displayed on the Weather Channel, are usually a few seconds in error and are not suitable for eclipse or occultation timings.

Video recording: Camcorders are now almost more commonplace than tape recorders. Of course, the audio part of camcorders can serve the function of tape recorders. But camcorders also can be used to videorecord a projected image of the Sun. Video and movie recordings seem to provide the best means of recording all of the complex Bailey's bead phenomena that occur near 2nd and 3rd contact during an eclipse, and these are the most important for determining the solar diameter from sites near the edges of the eclipse path.

It is difficult to attach a camcorder with a non-removable lens directly to a telescope, but this can be done with other video cameras with standard C-mount front ends. When Video recording an eclipse, I recommend against trying to get the whole image of the Sun in the frame as the resolution of the beads will not be very good. We have found that a field of view of 20′ (2/3rds of the Sun's diameter) or less gives adequate resolution of Bailey's beads. Whether observing by projection or directly with a filtered telescope and attached video camera, be sure that you have enough light. It may be better to use a small telescope rather than a telephoto lens. Eyepieces will crack if they are overheated when projecting the image. Even with filtered direct recordings, only record short parts of the partial phases and keep the front of the telescope covered most of the time. The important bead events all occur within about five minutes of second and third contact. Whatever you do, practice beforehand. If you can record details of sunspots, you can probably also record the Bailey's bead phenomena. Due to solar limb darkening, a slightly brighter exposure will record small bead events better.

WWV or other shortwave time signals should be recorded in the audio portion and, if possible, the time should be displayed on the video. A word of caution: Neither IOTA nor the U. S. Naval Observatory (USNO) have the resources to analyze all videotapes that are bound to be made of this eclipse. We expect to reduce observations from only a few of the tapes that best resolve the Bailey's bead phenomena.

If you observe an eclipse directly with a filtered telescope, you may need an aperture stop. This is a cover for the front of the telescope with a hole significantly smaller than the telescope aperture, in addition to a mylar or other filter, to obtain the right amount of light for video recording the Sun's edge without overexposure or blooming. If you make or buy an aperture stop, be sure that it is easily variable so that you can adjust the size of the aperture as needed during the observations without much disturbance. A simple way is to make slightly oversize holes in a piece of cardboard with a second piece that is taped in position.

For example, for the 1991 July eclipse, I used a 5-inch telescope with a mylar filter and a cardboard aperture stop (both easily removable) only about 1 inch in diameter to get the right amount of light during the partial phases. I recommend that you use two equal holes on opposite sides of the front-end cover. This will give you the full resolution of your telescope aperture and allow you to focus the image well. A single small hole makes focusing much less sensitive, which I discovered the hard way in 1991. As the light decreased when only a few beads remained visible, I removed the aperture stop, only to find that the full-aperture image was out of focus. I didn't realize until shortly after totality ended what the problem was and how to correct it.

Active and Inactive Cusps: The geometry of an annular eclipse near either the northern or southern limit causes the Bailey's bead events to occur mainly on one cusp of the expanding crescent before central eclipse and on the other cusp afterwards (this is also true of the shrinking crescent during a total eclipse). This helps visual observers and those with narrow-field video systems, since they can concentrate their attention on the cusp where the action is occurring, only occasionally switching to the other cusp to try to catch the few events that will occur there. Also, it is not necessary to try to measure the position angle of bead events, since for an eclipse of this magnitude, it will virtually always be possible to determine this from the time alone, and the fact that the event occurs on either the "active" cusp or the less- active one.

Bead Descriptions: If two or more beads are visible at the same time, visual observers should give some descriptive information, such as "disappearance of smaller of two beads farthest from the end of the active cusp". During annular eclipses, before central eclipse, you will see beads appear (or reappear) and merge as the active cusp enlarges to form a broken or complete ring at central eclipse (time of predicted simultaneous 2nd and 3rd contact). After central eclipse, the other cusp will become active, with beads forming (as lunar mountains break the end of the active crescent) and then disappearing. Visual observers can refer to the four types of bead events as "appear" or R (for reappear), "merge", "form", and D (for "disappear").

Visual and Other Techniques: In order to compare results with previously-observed eclipses (for example, useful video recordings of Bailey's beads have only been made since 1983), it will be useful to have observations of eclipses made by a variety of different techniques, such as video - direct telescopic or telephoto, filtered; video of projected image; visual of projected image; etc. This would be even more useful if the different-technique observations are made at the same site. For total eclipses, it is also useful to have direct naked-eye timings of 2nd and 3rd contact, preferably by many observers straddling the limits of totality, since before 1972, there are few observations made with more sophisticated techniques near the limits. However, as extensive observations made in Mexico during the 1984 May eclipse showed, this is NOT useful during annular eclipses like the one on May 10th. When a high background brightness remains throughout the eclipse, bead observations with naked eye (safely filtered, of course) or ordinary binoculars (filtered or projected image) do not have enough resolution for reliable bead timings, even for 2nd and 3rd contact.

For a large-magnitude eclipse like the one on May 10th, visual observers watching a projected image can time the 2nd and 3rd contacts, and most of the bead events, using a tape recorder and the same techniques used for timing grazing occultations of distant stars. Observations should be made for at least ten minutes, including at least five minutes before and after the UT of predicted simultaneous 2nd and 3rd contact at the inner edge of the northern or southern limit.

Focusing: Another point is that, unlike the Moon's edge, the edge of the Sun's photosphere is not perfectly sharp. So focus on the Moon's edge, not the Sun's edge. However, adjust the brightness level to achieve the sharpest edge of the Sun that you can, keeping the Moon's edge and sunspots in sharp focus. There is one point where the light gradient at the edge of the photosphere is steepest and different techniques should converge on the same point, but it is important to see what differences there might be with different aperture telescopes and different techniques.

Detailed Limit Predictions: Alan Fiala at USNO calculated predictions of the northern and southern limits of the path of the May 10th annular eclipse. The predictions included the positions and time for two limits, an "inner limit" and an "outer limit". The inner limit was the predicted limit for true annularity with the predicted time of simultaneous 2nd and 3rd contacts caused by the highest mountain tops of the lunar profile. South of the northern-limit inner edge and north of the southern-limit, a true annular eclipse with an unbroken ring will occur. The outer limit was where a broken annular eclipse occurs, with the largest break in the ring spanning 30° of position angle at central eclipse.

History of the Predictions: The predictions for the May 10th annular eclipse were computed by Alan D. Fiala at the U. S. Naval Observatory using a version of the Depthmod program, that I wrote several years ago, which he transported to a workstation. The program needs as input topocentric coordinates of the Moon's center relative to the Sun's center that were calculated by Mitsuru Sôma at the Japanese National Observatory in Mitaka using his OCCRED program; the solar and lunar ephemeris data were from the standard JPL ephemerides DE200/LE200.

It was encouraging that these predictions were in good agreement with independent calculations by Fred Espenak at the Goddard Space Flight Center. The agreement on the inner-edge predictions was 0."1-0."2, less than the Watts feature uncertainties. Espenak's outer edge predictions are about 1′ farther outside for each limit, apparently because he seems to be accepting a larger minimum broken segment. [See p. 40 for more about Espenak's predictions.]

Distribution of Information for the May 10th Eclipse: Most of the information above was distributed before the eclipse, but has been edited here to include mainly that of general interest which could be useful for future eclipses, including the total eclipse in November. Detailed predictions for the limits of the May 10th annular eclipse and observing information were mailed to all IOTA members and ON subscribers within about 300 miles of the path of annularity. About half of these observers received the information by E-mail rather than by regular mail.

LESSONS LEARNED FROM THE MAY 10TH ECLIPSE

David W. Dunham

Nearly everyone did something wrong during this eclipse; there will be few "perfect records", with all of the characteristics needed for a smooth and comprehensive analysis, on the composite tape mentioned above that we are producing. More mistakes made, and how they might be prevented, will be published in future issues.

In general, those who were able to observe from home, or who travelled to the eclipse in cars or vans, were able to take more equipment and use larger telescopes, and were consequently sometimes more successful, than those like myself who travelled to the eclipse by airplane. Since the Sun is bright, effective observations can be made with relatively small telescopes that can be transported by air. Since most solar eclipses in the near future will be observed by those travelling by air, my experiences during this eclipse might be of some value to them.

As always, I was very busy during the weeks and days before the eclipse, and was up most of the night before departure packing for both the IOTA meeting and the eclipse. Since I've been to several eclipses, I was overly confident in getting ready for this one. Of course, I forgot something, the equatorial wedge for my telescope, which I remembered shortly before my flight arrived in Houston, where I changed planes to go to El Paso. After a couple of phone calls, I arranged to borrow Don Stockbauer's wedge, which would be brought to me by Wayne Hutchinson, who was also planning to observe the eclipse from Sierra Blanca. Curiously, Don Stockbauer bailed me out the same way the last time I went to El Paso, in 1987 to observe a graze of Spica, when I also forgot my wedge! When Hutchinson gave me the wedge two hours before the eclipse, there was a note on it from Don: "For God's sake, make a checklist!" So on the flight back, I took his advice. It is copied below, since a version of it might be useful for others planning to videotape future eclipses. Your own checklist is highly recommended for IOTA expeditions that you undertake.

Checklist for Solar Eclipse Observations

Anvil metal case with foam padding
- C-5 Telescope
- Eyepiece holder & eyepieces
- Drive inverter and power cord
- Tools (pliers, slot & Phillips screwdrivers)
- Allen wrenches
- Clothes to keep things from rattling around
- Auto plug extension cord
- Small AC extension cord (usually not needed)

Tripod
- Green tripod carrier
- Map tube with maps & umbrella in middle
- Duct tape roll, clothes to make it tight

Can put in clothes suitcase:
- Mylar filter with cardboard protectors, all in plastic bag
- Portapac battery
- Old counterweights for telescope
- Scissors
- Cardboard
- Pieces of mylar for viewing & for finder

Celestron wedge (Can put in blue bag with collapsible wheeled dolly, or taken apart and put in clothes suitcase)

Video equipment in silver case
- Camcorder
  - connector for RF-video output
  - large battery (put in sock with C & T connectors)
  - battery charger
  - connector to battery charger
- Power Inverter
- 9-volt batteries (enclosed, one can be in C & T connector)
- Panasonic CCD video camera
- Electro-Voice microphone
- Audio mixer
- Small earphones
- 2 RCA cords, one for video & one for audio
- Male to 3 female autoplug

Male to 3 female AC power plugs
Small flashlight

But an equipment checklist is not all that I needed on May 10th. I was all set up half an hour before the interesting part of the eclipse started, everything checked out, so I turned everything off to conserve power. Five minutes before the observation, I turned things on, but was frustrated to find that the Sun had apparently drifted out of the field of view. After a couple of minutes of fruitless searching, I found that I had not turned the CCD camera on. About a minute after doing that, I acquired the Sun, adjusted to image the active cusp, and began recording. I kept making adjustments to keep the most interesting part in view; the beads were more detailed than I had recorded at previous eclipses. Fifteen minutes later, after the interesting part of the eclipse was over, I stopped the camcorder and turned off other equipment, only to discover that I had not turned on the audio mixer! There is very weak sound on the tape, but with noise from the telescope drive and other sources, it might not be possible to recover any time signals. Use of earphones to check the sound would have prevented that disaster, as would a checklist of things to do five minutes before an observation. So I've written one, reproduced below, and I urge you to prepare a similar one. Suggestions for additions to it are welcome.

Checklist for 5 minutes before starting observation

Turn Panasonic camera on
Be sure Panasonic camera is connected to camcorder
turn camcorder on in VCR - input mode
Be sure that the solar filter covers the telescope front end securely with no light leaks
Be sure that Sun & Moon are in field of view
Turn on audio mixer
Be sure that audio mixer is connected to camcorder
Be sure that microphone is connected to audio mixer
Make sure that audio mixer settings & connections are correct
Verify sound from camcorder or audio mixer using small earphones
Turn on telescope drive, if it is not on
Start recording with the camcorder
Follow image in camcorder viewer, adjust as needed

NASA ECLIPSE BULLETINS AND ECLIPSE PATHS 1995-1999 AVAILABLE VIA INTERNET

Fred Espenak

The NASA eclipse bulletins are provided as a public service to the international astronomical community and contain detailed predictions, maps and meteorological data for future central solar eclipses of interest. Response to the first two eclipse bulletins NASA Reference Publication 1301 (RP 1301, Annular Eclipse of 10 May 1994) and RP 1318 (Total Eclipse of 3 November 1994) has been overwhelming. Unfortunately, Jay Anderson and I have already run out of both publications and there are no plans for additional printings. Fortunately, the eclipse bulletins are now available over the Internet, due in large measure to the efforts of Dr. Joe Gurman (GSFC/Solar Physics Branch). They can be read or downloaded via the World-Wide Web server with a mosaic client from the SDAC (Solar Data Analysis Center) home page:
http://umbra.gsfc.nasa.gov/sdac.html
The top-level URL for the eclipse bulletins themselves are:
http://umbra.gsfc.nasa.gov/eclipse/940510/rp.html
and
http://umbra.gsfc.nasa.gov/eclipse/941103/rp.html

BinHex-encoded, StuffItLite-compressed version of the original Word and PICT files are available via anonymous ftp at
file://umbra.gsfc.nasa.gov/pub/eclipse
as are directories of the GIF figures, ASCII tables, and JPEG maps accessible through the Web.

In Table 6 of NASA RP 1301, the 'Int.' and 'Ext.' labels need to be switched; several observers noticed a discrepancy in these numbers.

Presently, the eclipse bulletins are available 12 to 18 months before each eclipse. We plan to increase the lead time to 24 months or more for future eclipses. Organizations can obtain copies of these future bulletins from Jay Anderson; Prairie Weather Centre; 900-266 Graham Ave.; Winnipeg, MB R3C 3V4; Canada; Internet address janders@ccm.umanitoba.ca. In these publications, Table 7 gives coordinates of the northern and southern limits of the path of annularity at 1° intervals of longitude. With this wide an interval, errors of 0.'5 or more can result from linear interpolation. Corrections to take into account the lunar profile to define the "graze" zones around the limits are given in Table 6. The uncertainty in the lunar profile data is usually greater than the error of linear interpolation.

A number of requests have been made for eclipse path data with an even greater lead time. To accommodate this demand, I am supplying tables for all central solar eclipses from 1995 through 2000. The eclipse path predictions were generated using the JPL DE/LE200 ephemeris using the center of mass for the Moon. No corrections have been made to adjust for center of figure. The value used for the Moon's mean radius is k =0.272281. The umbral path characteristics have been predicted at 2 minute intervals of time compared to the 6 minute interval used in "Fifty Year Canon of Solar Eclipses: 1986-2035". This should provide enough detail for making preliminary plots of the path on larger scale maps. Note that positive latitudes are north and positive longitudes are west. The paths for the following 7 eclipses are now available:

29 Apr 1995 - Annular Solar Eclipse
24 Oct 1995 - Total Solar Eclipse
9 Mar 1997 - Total Solar Eclipse
26 Feb 1998 - Total Solar Eclipse
22 Aug 1998 - Annular Solar Eclipse
16 Feb 1999 - Annular Solar Eclipse
11 Aug 1999 - Total Solar Eclipse

The path tables can also be accessed with Mosaic through the SDAC home page, or directly at URL: http://umbra.gsfc.nasa.gov/eclipse/predictions/eclipse-paths.html

Naturally, any comments, suggestions, etc. are always welcome. My address is NASA/Goddard Space Flight Center; Planetary Systems Branch; Code 693.1; Greenbelt, MD 20771; USA; Telephone: 301-286-5333; Internet: u32fe@lepvax.gsfc.nasa.gov

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PLANS FOR FUTURE SOLAR ECLIPSES

David W. Dunham

<u>1994 Nov. 3 total:</u> Expeditions for this eclipse are filling up quickly and most resources in the prime eclipse path sites in Peru, Chile, and Bolivia have already been committed. Especially, inexpensive air fares outside of the large tours are now difficult to find. You should act quickly if you want to join any of the efforts to observe near the edges of the path of totality mentioned below.

Although most of Paul Maley's expedition plans to observe near the central line near Tacna, Peru, one or two observers will be staying in Arequipa to observe from just inside the northern limit of the path of totality. More observers are welcome in Arequipa; for details, contact Paul Maley at the address and telephone given on p. 39, or communicate with him by e-mail (Internet) at: maley%jscdo6@jesnic.jsc.nasa.gov.

Tom Van Flandern is leading his second Eclipse Edge expedition to Chile, planning to observe from a site in the Atacama Desert near the southern limit about 50 km south of Arica. The prime site is near the main paved highway at an altitude of about 700 m; if fog or low marine clouds threaten on the morning of the eclipse, the expedition will be moved on primitive roads inland to sites as high as 2500 m. For details, contact Van Flandern soon at P.O. Box 15186; Chevy Chase, MD 20815; USA; telephone 1-202-362-9176; Internet metares@well.sf.ca.us. General information on the expedition may be obtained from a recorded message at 1-800-898-EDGE (1-800-898-3343).

Hans-Joachim Bode is organizing an IOTA/ES expedition to Bolivia to observe near the northern and southern limits. A few other German observers are planning to travel to Arica to observe near the southern limit in the Chilean Atacama Desert. Contact him at the address and telephone given on the last page of this issue, or contact him by e-mail at Internet address:

bode@kphunix.han.de.

They are working with a colleague who will be in Bolivia from July until the eclipse. Since our son's baby sitter is from La Paz and has contacts with Bolivian travel agencies, I also plan to join this effort in Bolivia. Americans interested in it should contact me, see p. 39 for address and phone, or use e-mail: David_Dunham@jhuapl.edu. But this is not an organized sightseeing/eclipse expedition; for that, Maley's or Van Flandern's expeditions are recommended. Information about travel and eclipse observing in Bolivia, from a central line perspective, is given in long articles by Joel Harris and Jay Anderson in the first issue (April 1994) of **The Eclipse Chaser's Digest**, an experimental publication with limited distribution (100 printed copies were made, but a larger number of copies are being distributed by e-mail by Jay Anderson; see Espenak's article on the previous page). On November 4-6, the League of Latin American Amateur Astronomers (LIADA) will be meeting in Tarija in southern Bolivia; the largest astronomical observatory in the country is there.

IOTA member Romualdo Lourençon; Rua Sao Jorge, 125 Centro; 13200-220 Jundiai, SP, Brazil, phone 55-11-434-8854, fax 55-11-406-7001, plans to coordinate observations of this eclipse in southern Brazil. Also planning to organize observations near the edges of the path of totality in Brazil is Oscar T. Matsuura; Chairman, Brazilian Acting Committee ECLIPSE 1994; Dept. Astronomia; Instituto Astronomômico e Geofísico; Universidade de São Paulo; Caixa Postal 9638; CEP 01065-970 São Paulo, SP, Brazil.

<u>1995 April 29 annular:</u> Paul Maley is organizing a possible expedition to Iquitos, Peru, to observe this from the southern limit. He had special weather observations

made in late April this year, which indicate a 70% chance of seeing the eclipse there. But an expedition to the northern limit is also needed, possibly to Ecuador or northeastern Brazil, and so far we know of no plans for such an effort. Some tables, maps, and weather data about this eclipse are in **The Eclipse Chaser's Digest**.

1995 Oct. 24 total: Weather prospects look very favorable for an expedition to northern India being organized by Paul Maley. Bead events for this eclipse should be spectacular since the path of totality is rather narrow, with the Moon's angular diameter only slightly greater than the Sun's.

PROPER USE OF GPS FOR OCCULTATION AND ECLIPSE OBSERVATIONS

David W. Dunham

In my April 28th message, "Observing the May 10th Annular Eclipse", I made some incorrect statements about GPS, due to my lack of experience with the system (I do not own a GPS receiver and have not used one, but have seen them demonstrated). Mark Trueblood gave me better information at the recent IOTA meeting in El Paso. The main error in the April 28th message is the discussion of using one GPS receiver, moving from a known site, to an observation site, then back to the known site again. That will not work due to the change in the degradation of the civilian GPS information. Unfortunately, this error is also repeated in section 4.3.1 (coordinates from GPS measurements) of the draft version of the IOTA Observer's Manual (issue of 19 March 1994); that section should be ignored and replaced with this article.

Global Positioning System (GPS) receivers are very handy for finding one's way around. Most of them have useful features, such as the ability to put in a line of position (defined by two longitude-latitude pairs). The unit can then be used to tell how far you are from the line. In this way, a GPS receiver can be valuable for navigating into a grazing occultation path, a solar eclipse limit line, or an updated asteroidal occultation path. In the field, GPS measurements can be used to check maps, allowing you to find your way even if new roads and buildings have been constructed since the map was published. Mark Trueblood published an article, "In the Shadow of the Asteroid", in **GPS World 4** (11), pp. 23-30 (Nov. 1993 issue), in which he describes applications of GPS for asteroidal occultations.

Unfortunately, single GPS measurements are now often being used for determination of geographical coordinates of observatories and other occultation observation sites. This is unacceptable, since the accuracy of single non-military (that is, standard degraded) GPS measurements is about 100 meters, three times larger than the minimum 30-meter (100-foot, or 1" of latitude or better) accuracy that we want for occultation and eclipse observations.

Averaging a very large number of measurements, collected over a period of at least half a day to use many different GPS satellites with different geometries, may reduce the error to acceptable values if done carefully. But often one does not have the time or resources to collect all of the necessary data. A better method is to use differential GPS, where accurate measurements can be made in certain areas where some companies have set up special GPS receivers at sites whose positions are accurately surveyed. Paul Maley describes one such system established by Trimble Navigation: "What we are going to do is to use their CBS system (community base station). There is one in Okla. City which records data continuously from a known position. I have been told that if I record data at my site for one second I could achieve a post mission differentially corrected solution accurate to within 3-5m. The longer I record the accuracy only goes to 2m even after a couple of hours. After the eclipse I will mail the receiver back to Trimble. They will download our recorded information, plus get data from the community base station in Oklahoma City and then run a program to reduce the site coordinates." There are about 350 CBS sites in the U.S.A.

If such a commercial system is not available, the same effect might be accomplished with two GPS receivers. One is used in the field to measure the coordinates of the sites there, while the other is kept at a geodetic marker (or other landmark with known coordinates, at least accurately scaled from a large-scale map) and where readings are made simultaneously (preferably within one second). So the readings need to be made according to a preplanned rigorous time table, or the person in the field keeps in communication with the person at the known landmark, calling out times when the readings must be made. At least a few readings should be made at each site to check consistency. Of course, the GPS satellites used at both sites must be the same, there must be 4 of them, and their geometry should be good. Apparently, an accuracy of better than 10 meters can be achieved with this method over distances up to about 500 km. Paul Maley calls this the "Base site - rover" system and plans to use it for the next eclipse trips that he is planning to Peru.

The geodetic datum of the readings must be the same, and must always be reported. The USNO detailed solar eclipse predictions, and IOTA's graze predictions, give local geodetic datum coordinates (1927 North American datum in North America; we prefer that you don't use the 1983 N.A.D. for now since it is not in our databases yet). For observations, it is not so critical, as long as the datum used is reported. The reduction programs also usually assume that reported coordinates are on local geodetic datum unless otherwise specified. Because of these problems, if you use GPS for reported coordinates, please give your own estimate of the accuracy achieved and describe how that accuracy was achieved. Otherwise, we must assume that single readings were made with an accuracy of 100 m, and the utility of the observations will be reduced significantly (and probably will not be used in final analyses).

Paul Maley, with help from Trimble Navigation, plans to write an article about use of GPS for ON. This will give some better and more specific information about GPS and how we can use it to obtain the accuracies that we need. Until that article is published, Paul Maley recommends the following good technical references on GPS:

a. Pathfinder General Reference Manual-only mildly technical covering a lot of practical issues

b. The Guide to GPS Positioning-slightly more technical but does not go into any issues in depth

c. GPS Satellite Surveying-extremely technical, very in depth, impossible to read.

He says, "I will locate where to get these and how much they cost. The general consensus is that the first reference is the best overall guide to how the technical aspects of GPS impact practical field usage."

LUNAR ECLIPSE NEWS

David W. Dunham, Doug Hube, Paul Maley, and Harold Povenmire

1993 Nov. 29: Detailed information about this eclipse, including Eberhard Riedel's graze maps and plans for observing some of these grazes, was given on pages 2-11 of the last issue. In particular, the occultation of ZC 646 was observed from both limits, as described on p. 10. The northern-limit effort in northern British Columbia netted more than 25 usable visual timings from 6 of the 8 stations; clouds prevented some timings at half of the stations in the southern part of the chain. An analysis of differential GPS measurements of the stations was recently completed and reported to Dunham.

The three observers at the southern limit in Baja Calif. each tried to videorecord the graze under clear skies, but only Paul Maley succeeded, obtaining 8 timings. His position was determined only with a single GPS receiver, needed for navigation since no detailed map of the area was available, so additional work will be needed in the future to establish an accurate position. In the meantime, we hope to complete a preliminary analysis of the available data in about a month.

Several other grazes during the eclipse were successfully observed in the U.S.A. Harold Povenmire's six-station Mississippi expedition to the intersection of the northern limits of the occultations of 53 Tauri and SAO 76565 was very successful, with multiple events seen for both grazes at many of the stations. Dunham videorecorded the 53 Tauri graze with image-intensified equipment at the start of totality near Jacksonville, NC, but got only two events when he set up a little farther south than planned due to new road construction not shown on the detailed USGS map of the area. A GPS receiver would have helped. More about grazes during this eclipse is in Richard Wild's article in the next issue.

The eclipse was much brighter than the one in December 1992, when occultations of 11th-mag. stars could be timed with 20-cm telescopes. Last November, 10th-mag. stars were difficult even on the relatively dark northern limb of the Moon. The weather was unusually cooperative, being clear over most of the southern and eastern USA.

1994 May 25: Eberhard Riedel gave me a map and table of grazes during this partial eclipse at the IOTA meeting in El Paso, but there was not time to distribute this material to the membership. The eclipse was shallow, with only southern-limit grazes occurring in the umbra. The only grazes in the mainland USA during the eclipse involved stars fainter than mag. 9.0, which probably were not observable, based on experience with last November's eclipse. Riedel predicted a graze of β Scorpii about 300 km south of Santiago, Chile, and in central Argentina, but the event occurred before first contact, during the rather bright penumbral phase. An umbral graze of 4.6-mag. ω^2 Scorpii crossed northeastern Puerto Rico. Two days before the eclipse, Dunham sent predictions to about 8 e-mail addresses in Puerto Rico listed in the American Astronomical Society's 1994 directory. There was only one response, from an observer who was out of town and didn't get the message until two days after the eclipse.

THE H.A.R.T. MOBILE OBSERVATORY

by
Craig Alan McManus
January 29, 1994

The Heartland Astronomical Research Team (H.A.R.T.) is based in Topeka, Kansas. We are five dedicated amateur astronomers (four of whom are IOTA members) who aspire to do research in astronomy and related fields. To achieve this goal we have combined our skills and money to set up a mobile observing system. I would like to share our set-up with others so that they can see what can be accomplished by a relatively small number of individuals who have a desire to do research.

The mobile unit is based out of a VW Campmobile. It has been modified only in the fact that it has an AC to DC convertor installed allowing the use of the VW's 12 volt system when it is on a 110 volt line. It constantly recharges the battery so that full 12 volt power is always available. The VW keeps our equipment warm in the winter with the help of a ceramic heater and keeps inclement weather out during any season. It is also a retreat for tired and hungry observers, since it has a bed on top and a stove to cook warm meals on and brew coffee. The van is also equipped with a refrigerator that runs on 12 volt, 110 volts, or propane. The VW seats four, has two swing out tables for equipment, and plenty of storage for all the items needed.

The power supply for all our equipment comes from a Honda EX 2200 generator that constantly supplies 2000 watts of power. It is extremely quiet and allows normal conversation within five feet of it. It has more power than we need at this time but the extra cost for the low noise level (<60db) will keep us from bothering residents near where we set up. This was a prime concern because all of our work is done at night and often in residential areas. It will run for seven hours or more on a single fill. The generator supplies power into the van via a high capacity cord. It is also available to run 100 volt equipment outside of the van through a separate power cord. We run all of the electronic equipment in the van through a Tripplite Isobar Ultra 8 power filter. This helps filter out any interference and smooths out any irregularities in the power flow.

The heart of the system is the electronics. The current imaging system is a CCD-PSA B & W camera from Tuthill. It has a sensitivity of .02 lux and runs on either 12 volt or 110. The pixel array size is 510 X 492. We have found it necessary to run the CCD on 12 volt to prevent a discernible rolling on the recordings.

The video signal from the CCD is sent to an AMIGA 500 computer with a Genlock attachment. The Alter Image Genlock is made by the DISC COMPANY. It allows us to overlay a digital time clock onto the video signal. The time signal is generated by a Heathkit GC-1000 Most Accurate Clock. It receives 5, 10, and 15 MHz. broadcasts of WWV. (Unfortunately, HEATH has decided to discontinue most of their kits and this was one they quit making. They have anther clock available but it can only receive 5 MHz.) When the signal is locked, the clock has an accuracy of +/- 5 msec. This is displayed visually on the clock to 0.1 second. We have found an external antenna is necessary for the clock. We encountered interference from the AMIGA and the generator at the WWV frequencies. A long wire antenna seemed to eliminate most of the interference so we have set up a portable quarter-wave antenna (at 5 MHz) that can be easily set up in less than five minutes. It runs a total of 100 feet. The time signal is run through a serial card in the clock to the serial port on the AMIGA at 9600 baud. The AMIGA runs a program that takes the serial signal from the clock and displays it in real time to 0.1 seconds on the monitor screen. The program to accomplish this was written by Russell Dyke and is available to those who request it. The GENLOCK combines the two signals (from the CCD and the clock) and sends the new video signal to a VCR where it is recorded on high quality tape. We have found that Maxell Black Magnetite to give us the best recording. It is far less grainy and noisy than most tapes available. This allows us to record fainter objects with more certainty.

A small monitor is set up by the telescope for the operator to use when guiding the telescope. The video signal for this monitor comes from the VCR and shows the combined signal so the operator will not guide the object under view in the time signals being recorded on the tape. We are assuming that by using frame by frame stepping through the recordings (at 30 frames per second) that we should be able to achieve ~.03 to .05 second accuracy for events when the clock is locked on WWV as indicated by the HISPEC light on the clock itself. The accuracy of the system is based on the fact that we are using 110 volt power instead of batteries for the recording system. We should not have to take into account the frames per second variations that occur with battery powered systems as the batteries get low on power.

H.A.R.T. owns the AMIGA and the GENLOCk. The rest of the equipment is owned by various members of the group. The 7" MEADE refractor we are using can reach magnitude 9.0 in a dark sky on a consistent basis. We also have a 10" SC available that can reach to about magnitude 9.5. Near the Moon, for grazes and occultations, the limits are somewhat brighter. This will allow us to videotape many of the grazes that we successfully observe visually each year. We are currently limiting ourselves to grazes of 8th magnitude or brighter. We are hoping that with the judicious use of filters we may be able to do bright limb and near full Moon grazes and occultations. The system will permit us to monitor a number of asteroidal occultations each year. Both telescopes are computer controlled, so finding objects and guiding on them is fairly easy. The hardest part is getting the object to be studied into the field of view of the CCD. Even on the refractor we are dealing with less than a 15' field at prime focus.

We have tried to physically isolate the different parts of the observatory from each other. The generator is typically located 20 feet from the VW with the telescope being located about 40 feet in the other direction. The antenna is run in a north-south direction and always to the west of the generator. We may build a Farraday cage or a permanent antenna at our dark sky observing site to eliminate any interference there.

We hope to expand the capabilities of the observatory to include photometric work by the middle of 1994. We are debating the various merits of different photometers and CCD photometry at this time.

We are always looking for projects to do in astronomy. Two or our members, Richard Wilds and myself, are working on the NASA lunar dust storm theory. Early NASA work had some indications of dust storms. We are hoping to help prove or disprove this theory by using blue stars grazing along the terminator. (See **ON** (**10**) 7. We are using a 486 machine and the reduction program MIRA to do this with a frame grabber. If you have any ongoing projects that we could help with, please contact us. Any suggestions or recommendations concerning the relative merits of photometers versus CCD photometry would also be greatly appreciated. H.A.R.T.'s address is

Heartland Astronomical Research Team
P.O. Box 3938
Topeka, KS 66604-6938

PARTIAL OCCULTATIONS BY CHIRON RECORDED

David W. Dunham

Predictions: I have been predicting occultations of faint stars by (2060) Chiron since shortly after the distant giant comet was discovered over 15 years ago, using mainly Astrographic Catalog data. During the last two years, Edwin Goffin has been calculating predictions of occultations of Guide Star Catalog (GSC) stars by Chiron as part of his asteroidal occultation predictions distributed to IOTA members around the world. During the last year, several professional astronomers have taken an interest in these events, and special predictions of GSC stars by Chiron during the next several years have been published by S. Bus *et al.* in **Astron. J. 107** (5), p. 1814 (May 1994). Preprints of these predictions were widely distributed about 9 months ago. The predictions for two of the events were updated with accurate astrometry with the 61-inch USNO astrometric reflector near Flagstaff, AZ, and partial occultations by Chiron and material in its vicinity have been reported in **International Astron. Union Circulars.**

1993 Nov. 7: On this date, a 7-second 80% occultation of a 14th-mag. star was recorded by R. Marcialis and IOTA member R. Hill, from the Univ. of Arizona, using a 14-inch Celestron at Tierra del Sol, CA, near the Mexican border in the mountains east of San Diego, as reported on **IAUC** No. 5898 (1993 Nov. 29). This could be a 166-km chord, but then the star would need to be double, with only the brighter component occulted. Preliminary spectra of the star do not indicate duplicity, but the results are not conclusive. The observations were made with a new CCD occultation system optimized for recording faint stars occulted by slow-moving outer Solar System objects. A brief description of this system is given by M. Buie *et al.* in **Bull. Amer. Astron. Soc. 25** (3), p. 1115 (1993 Div. Plan. Astron. abstracts).

At 3 other sites farther north in Calif. (Palomar, Ojai, and Table Mountain), shallower unresolved dips whose depth decreases with distance from Chiron were recorded at nearly the same time. These could be due to a narrow (less than 10 km wide) dust jet.

1994 March 9: **IAUC** No. 5965 (April 5) reports observations of the 11.9-mag. GSC star, also predicted by Goffin. J. Elliot and others recorded a 60% drop for one 0.5-second integration from the Kuiper Airborne Observatory when it was near Recife, Brazil. There were smaller drops in neighboring intervals. Teams of ground-based observers in Brazil were all clouded out. D. Kurtz recorded a 75% drop within half a second with the 0.5-m telescope at Sutherland, South Africa. These events are probably caused by jets or opaque satellites a few km wide "some hundreds of km from the nucleus".

REPORTS OF ASTEROIDAL APPULSES AND OCCULTATIONS

Jim Stamm

If you do not have a regional coordinator who forwards your reports, they should be sent to me at: 11781 N. Joi Dr. Tucson, AZ 85737 USA. Names and addresses of regional coordinators are given in "From the Publisher" on *Occultation Newsletter's* front page. All times in this report are UTC.

I have summarized all of the reports that I have received for the last half of 1991 in the following two tables and section of notes. Table 1 lists the 1991 date, minor planet, occulted star, IDs of successful observers, and references to any notes. Table 2 lists the observer's ID, name, nearest town to location of observation, country (includes state or province for North America and Australia), and the total number of observations made in the period. The notes section details those events that included positive observations, or other significant information that could not be reported in the tables. I am not including notes on those observations that may have been spurious unless there is some sort of confirmation, or the fact that something may have happened is relevant to another observation. Instead, I will place an asterisk (*) in the Notes column to indicate that I have received a report with more than a "no event....." in it.

Table 1. Asteroidal appulses and occultations: Jul.-Dec. 1991.

1991	Minor Planet		Cat	Star	Observers	Notes
Jul 02	56	Melete	PPM	173839	SmiThn	
Jul 03	130	Elektra	AGK3	-00° 2485	OveSmiDnz	
Jul 04	53	Kalypso	SAO	164223	CopOveSmiDae	
Jul 12	356	Liguria	LickV	5370	AndWad	
Jul 15	345	Tercidina	BD	+10° 0016	Hut	
Jul 17	124	Alkeste	LickV	8086	AndSmcHutDik	
Jul 17	899	Jokaste	SAO	157866	CopBomOveLunSmi	
Jul 29	598	Octavia	PPM	146995	Gea	
Jul 31	23	Thalia	SAO	210502	BlkSmc	
Aug 08	432	Pythia	SAO	166014	CopMcrMudThnOve	
Aug 10	191	Kolga	SAO	145388	HzlKaoKknScfSykSzl	
Aug 12	702	Alauda	PPM	67664		1
Aug 23	404	Arsinoe	SAO	185353	OveFrz	
Aug 24	55	Pandora	PPM	144459	AndStgSmc	
Aug 27	3	Juno	SAO	142983		2
Aug 29	214	Aschera	SAO	189138	AndHawSmc	
Sep 01	28	Bellona	AGK3	+08° 0383	AndHutSmc	
Sep 02	10	Hygiea	FAC	89903	Sam	
Sep 06	676	Melitta	SAO	161979	BlkNesLap	
Sep 08	133	Cyrene	PPM	181573	Hon	
Sep 08	198	Ampella	SAO	161512		3
Sep 10	20	Massalia	AC	2350875	Spr	
Sep 10	536	Merapi	SAO	129630	Dik	
Sep 10	1291	Phryne	PPM	118359	Dik	
Sep 11	1564	Srbija	SAO	162463	HawSmcWadOhk	4
Sep 15	505	Cava	PPM	120260	Sta	
Sep 22	1015	Christa	PPM	121250	Hon	
Sep 22	93	Minerva	PPM	92468	BulDflDnzDssKrt MosSpr	
Sep 27	1005	Arago	PPM	68338	GrhHon	
Sep 27	563	Suleika	SAO	187253	LapBlkSmcHutDik	
Oct 02	222	Lucia	LickV	23948	BlkLap	
Oct 03	14	Irene	AC	7305	Dnz	
Oct 10	18	Melpomene	SAO	160736	AndDikHut	5
Oct 12	345	Tercidina	AGK3	+08° 0136	Ewl	

Table 1 (Cont.). Asteroidal appulses/occultations: Jul.-Dec. 1991.

Oct 13	222	Lucia	AC	3372	CanDflDssMosWkl	
Oct 13	51	Nemausa	FAC	150783	HaySta	
Oct 13	386	Siegena	PPM	153875	Sta	
Oct 15	471	Papagena	SAO	79242	Rai	
Oct 17	387	Aquitania	SAO	148476	BlkNes	
Oct 21	920	Rogeria	SAO	145812	OveDaeProSmi	
Oct 27	731	Sorga	SAO	191046	BlkLap	
Nov 01	363	Padua	PPM	118793	DenSdrVac	
Nov 01	386	Siegena	PPM	177410	HonHoz	
Nov 02	796	Sarita	PPM	91790	DflDssMosPrc	
Nov 05	559	Nanon	SAO	190655	HonSta	
Nov 06	163	Erigone	PPM	125106	SenOka	
Nov 14	51	Nemausa	FAC	148516	Meu	
Nov 15	598	Octavia	PPM	120920	Ohk	
Nov 17	481	Emita	SAO	129205	IdaShiSah	
Nov 26	306	Unitas	LickV	30602	Dss	
Nov 31	6	Hebe	SAO	191604	OhkUdaTak	
Dec 04	51	Nemausa	FAC	135430	DhyDss	
Dec 11	598	Octavia	PPM	120466	DenEwlHalHbkJst KrtPlzSprWit	
Dec 12	22	Kalliope	AGK3	+26° 0444	WerVonNolOhk	
Dec 19	75	Eurydike	SAO	139268	BniBrtCanGrcIelSza	
Dec 20	451	Patientia	PPM	100727	SmcOhkMat	
Dec 20	451	Patientia	FAC	417482	BlkLapOhkMat	
Dec 21	148	Gallia	SAO	150507	WadOhkMat	
Dec 23	163	Erigone	PPM	125737	AndBlkSmcLap	
Dec 30	287	Nephthys	PPM	122416	SmiKhlBni	
Dec 31	50	Virginia	PPM	119895		6

Table 2. Observers and locations of events Jul.-Dec. 1991.

ID	Observer	Town	Country	No.
And	Anderson, Peter	The Gap	Queensland - AUS	8
Bak	Barnes, Karenne	Launceston	Tasmania	1
Bni	Baroni, Sandro	Milano	Italy	2
Bem	Bembrick, Colin	Bathurst	N.S.W. - AUS	1
Byo	Benyo, I	Rimavska Sobota	Czechoslovakia	1
Brt	Bertoli, Oreste	Alpignano	Italy	2
Bib	Birnbaum, C.	Abries	France	1
Blk	Blanksby, Jim	Wandin	Victoria - AUS	9
Bom	Boltman, A. & M.		South Africa	1
Bnn	Boninsegna, Roland	Abries	Belgium	1
Jbr	Bras, J.	Funchal	Portugal	1
Bry	Bryant, Ken	Langwarrin	Victoria - AUS	1
Bul	Bulder, Henk	Zoetermeer	Netherlands	1
Byr	Byron, Jeff	Sydney	N.S.W. - AUS	1
Cps	Campos Cucarella	Barcelona	Spain	1
Can	Candela, Bernard	Sollies-Pont	France	3
Cvg	Cavagna, Marco	Sormano	Italy	1
Cop	Cooper, Tim	Benoni	South Africa	3
Cmg	Csomos, G.	Csicso	Hungary	1
Dfl	Daiffallah, Khalil	Alger	Algeria	4
Dae	Dale, S.	Pietermaritzburg	South Africa	2
Dpr	De La Puerta, H.		Spain	1
Dhy	Delahaye, F.	Bordeaux	France	1
Den	Dentel, Martin	Berlin	Germany	3
Dnz	Denzau, Helmut	Essen	Germany	3
Dik	Dickie, Ross	Gore	New Zealand	6
Dss	Dusser, Raymond	Kalaa Sghira	Tunisia	5
Eng	Engra Hinarejos	Valencia	Spain	1
Ewl	Ewald, D.	Biesenthal	Germany	3
Faf	Farrell, Fraser	Hockham West	Australia - AUS	1
Fau	Faure, G.	Grenoble	France	1
Fda	Fernandez Arozena	La Palma	Spain	1
Fnz	Fernandez Barba	Barcelona	Spain	1
Fld	Fldrich, R.	Bakonycsernye	Hungary	1
Afy	Fily, A.	Abries	France	1
Flo	Flores Martinez	Valencia	Spain	1
Frz	Frazer, B.	Johannesburg	South Africa	1
Glo	Gallo, Vicenzo	Salerno	Italy	1
Grc	Garcia, Joaquim	Lisboa	Portugal	1
Ygt	Gautier, Y.	Abries	France	1
Gea	George, Anthony	Salem	Oregon - USA	1
Gir	Giller, Roger	Engadine	N.S.W. - AUS	1
Gcv	Goncalves, Rui	Lisboa	Portugal	1
Gzl	Gonzalez, M.	El Escorial	Spain	1

Table 2 (Cont.). Observers/locations of events: Jul.-Dec. '91.

Table 2 (Cont.). Observers/locations of events: Jul.-Dec. '91.

Grh	Graham, Frances	E. Pittsburg	Pennsylvania - USA	1
Gre	Green, Peter	Hobart	Tasmania	1
Gri	Grida, Joe	Aberfoyle Pk	Australia - AUS	1
Gdi	Gualdoni, Carlo	Asiago	Italy	1
Hal	Halir, K	Rokycany	Czechoslovakia	1
Hzl	Hanzl, D	Brno	Czechoslovakia	4
Hbk	Hasubick, Werner	Buchloe	Germany	1
Tvh	Haymes, Tim V.	Reading	United Kingdom	1
Hay	Hays, Robert	Worth	Illinois - USA	1
Haw	Hayward, Steve	Madang	Papua New Guinea	2
Hrr	Heredero, R.	El Escorial	Spain	1
Hil	Hill, Kym	Hobart	Tasmania	1
Hof	Hoffmann, E.	Raktanya	Hungary	1
Hok	Holler, Klaus	Graz	Austria	1
Hoz	Holtz, John	Russellton	Pennsylvania - USA	1
Hon	Honkus, Edward	Carnegie	Pennsylvania - USA	5
Hsz	Horvath, S.	Csicso	Hungary	1
Hrh	Hroch, F.	Brno	Czechoslovakia	1
Hut	Hutcheon, Steve	Sheldon	Queensland - AUS	6
Ida	Ida, Miyoshi	Youkaichi	Japan	1
Iel	Ielo, Antonio	Perugia	Italy	2
Jst	Jahn, Jost	Velzen	Germany	1
Jaz	Jakab, Z.	Csicso	Hungary	1
Kis	Kiss, L.	Szeged	Hungary	2
Koc	Kocsis, Antal	Balatonkenese	Hungary	1
Khl	Kohl, Mike	Wald	Switzerland	1
Kkn	Kosa-Kiss, Attila	Salonta	Romania	2
Kao	Krakow Obs.	Krakow	Poland	2
Krt	Kretlow, Mike	Siegen	Germany	2
Kru	Kruijshoop, Alfred	Mt. Waverly	Victoria - AUS	1
Kub	Kubicek, P.	Teplice	Czechoslovakia	1
Lap	Larkin, Patricia	The Basin	Victoria - AUS	7
Lry	Leroy, M.	Abries	France	1
Lhd	Lindhard, L.	Esbjerg	Denmark	1
Lkn	Loeken, T.		Germany	1
Loz	Lomoz, F.	Sedlicany	Czechoslovakia	1
Lzn	Lozano, T.		Spain	1
Lun	Lund, H.	Johannesburg	South Africa	1
Mti	Marti, Josep	Mataro	Spain	1
Dmd	Martinez, David	Cordoba	Spain	1
Mrx	Marx, Harald	Stuttgart	Germany	1
Mat	Matsuda, Hideki	Tenri	Japan	3
Mcr	McRae, A.	Rustenburg	South Africa	1
Mom	Monk, Mark	Monterey	N.S.W. - AUS	1
Mos	Mostefaoui, Toufik	Alger	Algeria	4
Mud	Mulder, M.	Thabazimbi	South Africa	1
Nas	Nagy, S.	Csicso	Hungary	1
Nes	Nelson, Peter	Ellinbank	Victoria - AUS	3
Neu	Neureiterova, E.	Brno	Czechoslovakia	2
Nol	Nolthenius, R.	Aptos	California - USA	1
Nor	North, Roger	N. Lidcombe	NSW - AUS	1
Meu	Obser. De Meudon	Meudon	France	1
Oka	Okada, Ichiro	Taga	Japan	1
Ohk	Okura, Nobuo	Okayama	Japan	7
Otp	Otazu Porter, X.	Alcampell	Spain	1
Ove	Overbeek, Danie	Edenvale	South Africa	6
Plz	Palzer, Wolfgang	Wiesbaden	Germany	2
Paa	Patak, A.	Pecs	Hungary	2
Pir	Piriti, J.	Nagykanizsa	Hungary	2
Prc	Porcini, Roberto	Salerno	Italy	2
Pro	Prosser, G.	Pietermaritzburg	South Africa	1
Rai	Rain, Manfred	Nettetal	Germany	1
Ray	Rapavy, P.	Rimavska Sobota	Czechoslovakia	1
Rsp	Raspadori, G.	Bologna	Italy	1
Rch	Richter, Steffen	Berlin	Germany	1
Rod	Rodriguez, Diego	Avila	Spain	1
Sam	Samolyk, G.	Milwaukee	Wisconsin - USA	1
Sdr	Sandor, O.	Teplice	Czechoslovakia	1
Sap	Sapi, C.	Kecskemet	Hungary	1
Sar	Sarrazin, M.	Reims	France	1
Sah	Satoh, Isao	Ichinomiya	Japan	1
Scf	Scarfi, G.	La Spezia	Italy	1
Sen	Sendai City Obs.	Sendai	Japan	1
Shi	Shibuya, Youto	Ichinomiya	Japan	1
Syk	Slusarczyk, Janusz	Kobielnik	Poland	2
Smi	Smit, J.	Pretoria	South Africa	6
Smc	Smith, Charlie	Woodridge	Queensland - AUS	10
Spr	Springob, C	Siegen	Germany	3
Stg	St. George, Lou	Auckland	New Zealand	2
Sta	Stamm, Jim	Tucson	Arizona - USA	4
Sza	Szabo, Sandor	Sumegcsehi	Hungary	1
Szk	Szarka, Levente	Kecskemet	Hungary	1
Szc	Szolcsanyi, Gyorgy	Szentendre	Hungary	1
Szl	Szollosi, Attila	Veszprem	Hungary	2
Tak	Takahashi, S.	Taga	Japan	1
Thn	Thompson, R.		South Africa	2
Trl	Torrell, Sebastia	Barcelona	Spain	1
Tou	Touret, N.	Reims	France	1
Tre	Tregaskis, Bruce	Mt. Eliza	Victoria - AUS	1
Tlp	Tulipani, F.	Bologna	Italy	1
Uda	Uda, Kiyo	Shigaraki	Japan	1
Vac	Vaclav, P.	Praha	Czechoslovakia	1
Vce	Velasco, E.	El Escorial	Spain	1
Vco	Velasco, Pedro	El Escorial	Spain	1
Vgr	Viger, D.	Villejuif	France	1
Vcz	Vincze, Ivan	Raktanya	Hungary	1
Von	Von Ahnen, Karl	Aptos	California - USA	1
War	Warell, J.	Angelholm	Sweden	1
Wad	Watson, Diana	Whakatane	New Zealand	3
Wer	Werner, David	Lakewood	California - USA	1
Wst	Westlund, M.	Uppsala	Sweden	1
Wkl	Winkel, J.-M.	Arnhem/Lunas	Netherlands	1
Wtt	Witt, U.	Berlin	Germany	1

NOTES:

1 Aug 12 (702) Aluda. 47 observers (Afy Bib Bnn Brt Can Cmg Cvg Dmd Dpr Fda Gcv Gdi Gzl Hof Hrr Hsz Hzl Jaz Jbr Kao Kis Kkn Kub Lhd Lkn Lry Lzn Mti Nas Neu Otp Pir Plz Rod Sar Syk Szl Tou Trl Tvh Vce Vco Vcz Vgr War Wst Ygt) at 28 stations monitored this event.

2 Aug 27 (3) Juno. Observers were: Dfl Fid Hok Hzl Iel Kis Koc Loz Mos Mrx Neu Paa Rsp Szc Szk Tlp.

3 Sep 08 (198) Ampella. See [O.N. 5(12), p.315]. Observers were: And Gri Faf Bem Byr Mom Nor Gir Stg Blk Kru Bry Tre Lap Hut Ncs Bak Hil Gre Smc Dik.

4 Sep 11 (1564) Srbija and SAO 162463. Nobuo Ohkura obtained a 4.5 sec. photoelectric occultation beginning at 12:38:41 from Okayama, Japan.

5 Oct 10 (18) Melpomene. See [O.N. 5(12), p.315].

6 Dec 31 (50) Virginia. See [O.N. 5(12), p.315]. Observers were: Byo Cps Den Eng Ewl Fau Flo Fnz Glo Hrh Hzl Paa Pir Prc Ray Rch Sap.

The International Occultation Timing Association was established to encourage and facilitate the observation of occultations and eclipses. It provides predictions for grazing occultations of stars by the Moon and predictions for occultations of stars by asteroids and planets, information on observing equipment and techniques, and reports to the members of observations made. IOTA is a tax-exempt organization under section 509(a)(2) of the (USA) Internal Revenue Code, and is incorporated in the state of Texas.

The ON is the IOTA newsletter and is published approximately four times a year. It is also available separately to non-members.

The officers of IOTA are:

President	David W. Dunham
Executive Vice President	Paul Maley
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Addresses, membership and subscription rates, and information on where to write for predictions are found on the front page.

The Dunhams maintain the occultation information line at 301-474-4945. Messages may also be left at that number. When updates become available for asteroidal occultations in the central U.S.A., the information can also be obtained from either 708-259-2376 (Chicago) or 713-488-6871 (Houston).

Observers from Europe and the British isles should join IOTA/ES, sending DM 40.-- to the account IOTA/ES; Bartold-Knaust Strasse 8; 3000 Hannover 91; Postgiro Hannover 555 829 - 303; bank-code-number (Bankleitzahl) 250 100 30. Full membership in IOTA/ES includes the supplement for European observers (total and grazing occultations) and minor planet occultation data, including last-minute predictions, when available.

The addresses for IOTA/ES are:

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